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For the attention of: Barnaby Hoyal

Your ref:
Our ref: RW/LJB/Y1895
Date: 1 June 2007

Dear Sirs

Patent Application:	**03256537.6**
Country:	**European Patent Office (EPO)**
Applicant:	**Samsung Electronics Co., Ltd.**
Title:	**Air Purifier**

In response to the examination report dated 10 May 2007, we enclose herewith amended pages 1 to 8 of the description and amended claims page 9 to 13, which pages should take the place of the specification already on file. The amendments have been made with a view to overcoming all of the examiner's objections.

In claims 1 and 2, the term "replaceable" has been amended to "interchangeable with other functional filters". The basis for this amendment can be found on page 6, lines 24 to 36, and page 7, lines 11 to 27. This amendment distinguishes the interchangeability of the functional filters for different situations in which different types of contaminant are to be removed, from the replaceability of the filters when they become clogged or unusable.

Claims 10, 12 and 25 have been amended to be dependent on claim 1.

Claim 9 has been amended to incorporate the subject matter of claim 23, i.e. that the removal of volatile organic compounds from the air eliminates harmful gases in the air.

Claim 11 has been deleted from the application, because it is a repetition of claim 4.

Claims 17 to 19 have been deleted from the application, because they are repetitions of claims 1 to 3.

Claims 20 to 23 and claims 29 to 32 have been deleted from the application, because they are repetitions of claims 6 to 9.

The remaining claims have been renumbered accordingly.

It is submitted that the term "functional filter" appearing in many of the claims of the application is further defined on page 6, line 7 to 15. Here, it is stated that the functional filter should have the ability to remove desired contaminants, deodorise, sterilise and/or treat VOCs. Consequently, this term is clearly defined.

With regard to the examiner's objections raised in section B of the examination report, it is respectfully submitted that the prior art documents do not disclose the use of functional filters which are adapted to be interchangeable with other functional filters on the basis of the types of contaminants to be purified. It is therefore submitted that claim 1 of the application is novel over the prior art documents.

It is further submitted that the use of interchangeable filters is inventive in view of the prior art documents. The use of interchangeable filters allow the same device to be used effectively in any situation, and to remove any desired type of contaminants, whereas the devices disclosed in the prior art documents would only be effective at removing a certain type of contaminant. A separate device of the type disclosed in the prior art would, therefore, need to be used for each different type of contaminant. Therefore, the device of the present invention allows a single device to be operable in any conditions, thus reducing equipment costs for the user and increasing the flexibility of use of the device.

References to D1 and D2 have been made on page 2 of the description.

The statements of invention have been deleted from the application, and reliance is made on a reference to the claims on page 2 of the description.

The final paragraphs of the application, on pages 8 and 9, have been deleted.

It is submitted that the application is now in order for acceptance.

Please Note

In so far as any amendment submitted herewith deletes subject-matter (including any claim) from any of the application documents, the Applicant does not abandon such subject-matter unconditionally and reserves the right to restore such subject-matter to the application documents at a later date and/or to file a divisional application.

If any objections remain outstanding then we would welcome a telephone call from the Examiner. We request that any further objections be raised in a further Examination Report, if necessary. As the next measure we request an informal interview with the Examiner. As a last resort we request Oral Proceedings before any adverse decision is taken, including refusing this application.

Yours faithfully
APPLEYARD LEES

WADDINGTON, Richard
Authorised Representative

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AIR PURIFIER

The present invention relates, in general, to air purifiers and, more particularly, to an air purifier for use in providing clean air by removing dust, bacteria and contaminants in air.

As is well known to those skilled in the art, an air purifier is used to provide purified clean air after dust, bacteria and contaminants in the air are eliminated. The air purifier is provided with a dust collecting unit to collect dust, etc. In the dust collecting unit, dust particles electrically charged by corona discharge of an ionizer are collected by electrostatic attraction of a electrostatic filter having a polarity opposite to the polarity of the charged dust particles.

FIG. 1 is a side sectional view of a conventional air purifier. As shown in FIG. 1, the conventional air purifier includes a pre-filter 102, an ionizer 104, a electrostatic filter 106 and a final filter 108. The pre-filter 102 acts primarily to filter relatively large dust particles. The ionizer 104 functions to charge the dust particles electrically to bear a positive polarity by corona discharge between a discharge electrode 104b and ground electrodes 104a positioned at both sides of the discharge electrode 104b. The electrostatic filter 106 has a plurality of horizontal partitions 106a bearing a negative polarity. When the positively charged dust particles flow between the horizontal partitions 106a of the electrostatic filter 106, the dust particles are adsorbed and collected on the negatively charged

horizontal partitions by electrostatic attraction. The final filter 108 functions to filter fine dust or bacteria not filtered by the electrostatic filter 106.

However, the conventional air purifier which filters dust, bacteria and contaminants suffers from exhibiting no functions of deodorization, sterilization and removal of hazardous components such as VOCs (volatile organic compounds). Particularly, bacteria may be filtered by the final filter 108, but the air is not completely sterilized. Hence, worry over propagation of the bacteria in the final filter 108 increases. The conventional air purifier is thus not completely effective due to lack of provision of various air purification functions.

JP 2000 217900 discloses an air cleaning method and air cleaner.

JP 2000 084056 discloses a deodorising and dust collecting filter and air cleaner equipped with the same.

It is an aim of the present invention to address the above mentioned disadvantages.

According to the present invention there is provided an apparatus and method as set forth in the appended claims. Preferred features of the invention will be apparent from the dependent claims, and the description which follows.

These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the preferred embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a side sectional view of a conventional air purifier;

FIG. 2 is a perspective view of an air purifier, according to an embodiment of the present invention;

FIG. 3 is an exploded perspective view of the air purifier shown in FIG. 2 ;

FIG. 4 is a view illustrating a process of removing a functional filter through a filter replacing port of the air purifier shown in FIG. 2; and

FIG. 5 is a view illustrating functions of the air purifier shown in FIG. 2.

Reference will now be made in detail to the present preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

Embodiments of an air purifier according to the present invention are described in detail with reference to FIGS. 2 to 5. FIG. 2 is a perspective view of an air purifier, according to the present invention. As shown in FIG. 2, a main body 202 of the air purifier is equipped with a cover 204 at a front surface thereof, in which the cover 204 is formed with a plurality of air suction slits 204a so that external air is sucked into the main body 202. That is, through the air suction slits 204a, contaminated air is sucked into the main body 202, which functions to remove dust particles, hazardous components and offensive odors, thus purifying the contaminated air. The purified air is

discharged outside the air purifier through an air exhaust port (not shown) positioned at a back surface of the main body 202. At a side surface of the main body 202, a filter replacing port 208 is provided to insert or remove a functional filter in accordance with an embodiment of the present invention.

The air purifier is provided with various constituent units necessary for air purification, in addition to the functional filter as mentioned above. FIG. 3 is an exploded perspective view of the air purifier according to an embodiment of the present invention. As shown in FIG. 3, the air purifier according to the present invention includes a pre-filter 302, an ionizer 304, a electrostatic filter 306, a metal filter 308, a HEPA (High-Efficiency Particulate Air) filter 310, a functional filter 312 and photo catalytic filters 314, sequentially disposed from the front to the back of the main body 202 thereof. Further, a fan 316 is equipped at the very rear of the main body 202 to forcibly circulate air from the front to the back of the main body 202. While the fan 316 is rotated, air flows from the front to the back of the main body 202, so that room air is circulated through the air purifier.

Each filter and dust collecting unit shown in FIG. 3 functions as follows. The pre-filter 302 is used primarily to filter relatively large dust particles. The ionizer 304 and the electrostatic filter 306 serve as an electric dust collecting unit, in which dust particles being positively charged in the ionizer 304 are adsorbed and collected to the negatively charged electrostatic filter 306 by electrostatic attraction. The dust

particles remaining in the air after passing through the electrostatic filter 306 are filtered through the metal filter 308. The metal filter 308 includes two metal nets having very fine meshes and a plurality of fabric materials interposed between the metal nets, and is electrically grounded to have a negative polarity as in the electrostatic filter 306, thus adsorbing the positively charged dust particles. In the air purifier according to the present invention, dust particles or contaminants, which are not collected in the electrostatic filter 306, are further filtered by the metal filter 308, thus increasing air purification performance, decreasing a filtering burden of the HEPA filter 310 positioned behind the metal filter 308, and lengthening a service life of the HEPA filter 310. Since the HEPA filter 310 is much more expensive than the other filters, extension of service life of the HEPA filter 310 results in a high quality end product, thus generating economic benefits. Moreover, when being made of a washable material, such as a metal or polypropylene, the pre-filter 302, the ionizer 304, the electrostatic filter 306 and the metal filter 308 are semipermanently used, thus further extending the service life of the HEPA filter 310.

The HEPA filter 310 is used to collect microparticulates such as fine dust or bacteria having a very small particle size, i.e., generally has a minimum efficiency of approximately 99.97% for aerosolized DOP (di-octyl-phthalate) (e.g., about 0.3 μm). Compared to the other filters, it is difficult to prepare the HEPA filter 310 with a microstructure necessary for filtering the microparticulates, thus increasing a preparation cost thereof. On the other hand, based on a kind of

contaminant to be removed, the functional filter 312 disposed behind the HEPA filter 310 may be replaced with, at any time, a filter having an ability to remove the desired contaminants. The functional filter 312 may function to deodorize, sterilize and/or treat VOCs. In addition, any filter having various functions needed for air purification may be used, thus increasing air purification efficiency. The photocatalytic filters 314 act as a deodorizing filter which eliminates odors from air through reaction of a chemical material coated on the photocatalytic filters 314 with ultraviolet rays generated from ultraviolet lamps 314a positioned between the filters 314.

FIG. 4 is a view illustrating a removal process of the functional filter through the filter replacing port of the air purifier according to the present invention. As shown in FIG. 4, the filter replacing port 208 formed at a side surface of the main body 202 is opened, and the functional filter 312, which has already been disposed in the main body 202, is removed from the main body 202, after which another functional filter is inserted into the main body 202, thus completing replacement of the functional filter 312. One side end of the functional filter 312 is formed with a slot 312a to remove the filter 312 easily from the filter replacing port 208. Through replacement of the functional filter 312, removal efficiencies of the contaminants of the air purifier according to the present invention are further increased. For example, a replaceable deodorizing filter is used in foul-smelling environments, thus exhibiting a deodorization function. In addition, in the case of carpeted indoor spaces, noxious bacteria such as ticks or molds are propagated,

and thus, a replaceable sterilizing filter is used to remove the noxious bacteria from the air. Further, various VOCs are contained in the air in regions close to industrial equipment or new buildings. In such a case, a functional filter to remove VOCs is used to increase a removal function of the VOCs.

The functional filter 312 is prepared by incorporating a specific material for air purification into micropores of carbon nanotubes, thus exhibiting various functions of deodorization, sterilization and removal of VOCs. That is, the functional filter 312 according to the present invention has different removing functions based on the functional material confined in the micropores of the carbon nanotubes. For instance, when titanium oxide (TiO_2) is confined in the carbon nanotubes, a deodorization function is enhanced. Use of silver (Ag) results in an increased sterilization function, while use of nickel (Ni) leads to increased removal function of VOCs. A seller of the air purifier according to the present invention handles various functional filters having enhanced specific functions, and such filters are basically sold together with the air purifier or may be sold individually.

FIG. 5 is a view illustrating functions of the air purifier shown in FIG. 2 . As shown in FIG. 5, when contaminated air passes through the pre-filter 302, relatively large dust particles are filtered. By corona discharge between a discharge electrode 304b and ground electrodes 304a, positioned at both sides of the discharge electrode 304b in the ionizer 304, the dust particles are positively charged. The dust particles electrically

charged in the ionizer 304 are adsorbed and collected on a surface of the ground electrode 304a. The electrostatic filter 306 has pluralities of partitions 306a having a honeycombed structure, in which the partitions 306a are negatively charged. Thus, the positively charged dust particles are adsorbed and collected on the negatively charged partitions 306a by electrostatic attraction. Fine dust particles remaining in the air after passing through the electrostatic filter 306 are further filtered by the metal filter 308. The HEPA filter 310 collects fine dust particles or molds which are not filtered by the electrostatic filter 306 or the metal filter 308. The functional filter 312, positioned in back of the HEPA filter 310, provides various air purification functions based on a kind of specific materials confined in the micropores of the carbon nanotubes. The photocatalytic filters 314 function to remove odors from the air by reaction of a chemical material coated on the filters 314 with ultraviolet light 314a.

As is apparent from the above description, the present invention provides an air purifier having an enhanced purification function relative to specific contaminants through replacement of a filter on the basis of environmental properties of a space to be purified, thus exhibiting various air purification functions required according to various environmental conditions. That is, by use of a single air purifier, various contaminants are removed, thus increasing purification functions as well as utility of the air purifier. Further, the collection of dust through multi-stages leads to decreasing the filtering burden of the expensive filter, thus lengthening a service life of the air purifier.

CLAIMS:

1. An air purifier, comprising:

a main body (202) to suck and discharge air;

a dust collecting part (302-310) to collect dust particles;

a functional filter (312) to enhance a purification function to predetermined contaminants in the air and adapted to be interchangeable with other functional filters on a basis of types of contaminants to be purified; and

a deodorizing filter (314) to remove odors from air,

wherein the dust collecting part (302-310), the functional filter (312) and the deodorizing filter (314) are received into the main body (202) to remove the contaminants from the air sucked into the main body (202).

2. The air purifier of claim 1, wherein a replacing port (208) of the functional filter (312) adapted to be interchangeable with other functional filters on the basis of the types of contaminants to be purified is formed on the main body (202).

3. The air purifier of claim 2, wherein the replacing port (208) of the functional filter (312) is formed at any one portion of a side surface and a top surface of the main body (202).

4. The air purifier of any preceding claim, wherein the dust collecting part (302-310) comprises a washable material.

5. The air purifier of any preceding claim, wherein the dust collecting part (302-310) comprises:
a pre-filter (302) received into the main body (202) to collect impurities larger than dust particles;
an ionizer (304) to charge dust particles electrically;
an electrostatic filter (306) exhibiting static electricity to collect the dust particles charged in the ionizer (304);
a metal filter (308) including a fabric material inserted between two metal nets; and
a high density filter (310) to collect micro-contaminants.

6. The air purifier of any preceding claim, wherein the functional filter (312) comprises a functional material confined in micropores of carbon nanotubes, and has a purification function of contaminants corresponding to the functional material.

7. The air purifier of any preceding claim, wherein the functional filter (312) comprises nano-sized titanium oxide confined in carbon nanotubes, and functions to remove odors from the air to deodorize the air.

8. The air purifier of any preceding claim, wherein the functional filter (312) comprises silver confined in micropores of carbon nanotubes, and functions to remove hazardous bacteria in the air to sterilize the air.

9. The air purifier of any preceding claim, wherein the functional filter comprises nickel confined in micropores of carbon nanotubes, and functions to remove volatile organic compounds from the air to eliminate harmful gases in the air.

10. The air purifier of any preceding claim, wherein the dust collecting part (302-310) comprises a high-density filter (310) to remove micro-contaminants;

11. The air purifier of any preceding claim, further comprising:
a prefilter (302) received into a main body (202) of this air purifier to collect impurities larger than dust particles;
an ionizer (304) to electrically charge dust particles;
an electrostatic filter (306) exhibiting static electricity to collect the dust particles charged in the ionizer (304); and
a metal filter (308) including a fabric material inserted between two metal nets.

12. The air purifier of claim 5, one of claims 6 to 9 when dependent on claim 5 or claim 11, wherein an electrically charged polarity of the ionizer (304) is opposite to a polarity of the metal filter (308).

13. The air purifier of claim 5, one of claims 6 to 9 when dependent on claim 5, claim 11 or claim 12, wherein the fabric material comprising the metal filter is a metal.

14. The air purifier of claim 5, one of claims 6 to 9 when dependent on claim 5, claim 11 or claim 12, wherein the fabric material comprising the metal filter is polypropylene.

15. The air purifier of claim 5 or one of claims 6 to 9 when dependent on claim 5 or claim 10 wherein the high-density filter (310) is a HEPA filter.

16. The air purifier of any preceding claim, wherein the deodorizing filter (314) comprises two sheets, each coated with a photocatalytic material and an ultraviolet light source mounted therebetween.

17. The air purifier of any preceding claim, wherein the dust collecting part (302-310) comprises:
a dust collecting unit (304-308), to charge dust particles electrically and to collect the dust particles by electrostatic attraction; and
a HEPA filter (310), to collect micro-contaminants.

18. The air purifier of claim 17, wherein the dust collecting unit (304,306) includes:
an ionizer (304), to charge dust particles electrically; and
an electrostatic collector (306), to collect the dust particles by electrostatic attraction.

19. The air purifier of claim 18, further including at least one of:
a metal filter (308), located immediately prior to the HEPA filter (310), to collect the dust particles charged in the dust collecting unit; and
a functional filter (312), located immediately following the HEPA filter (310).

20. The air purifier of claim 19, wherein the functional filter (312) is a photocatalytic filter.